Figure 1a

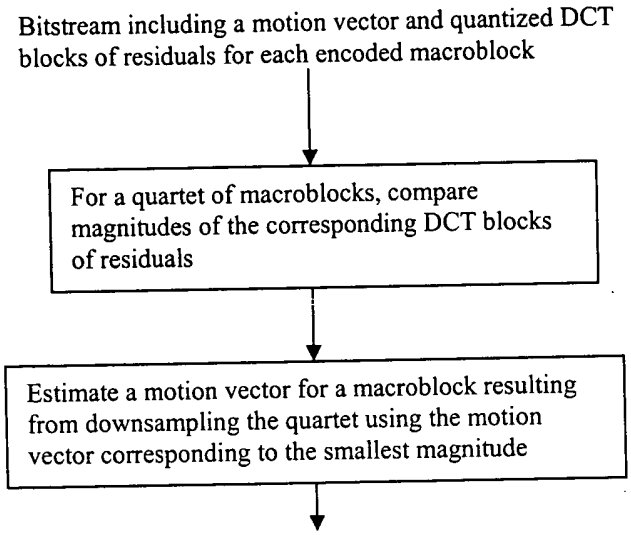

Bitstream including a motion vector and quantized DCT blocks of residuals for each encoded macroblock
For a quartet of macroblocks, compare magnitudes of the corresponding DCT blocks of residuals
Estimate a motion vector for a macroblock resulting from downsampling the quartet using the motion vector corresponding to the smallest magnitude

Figure 1b

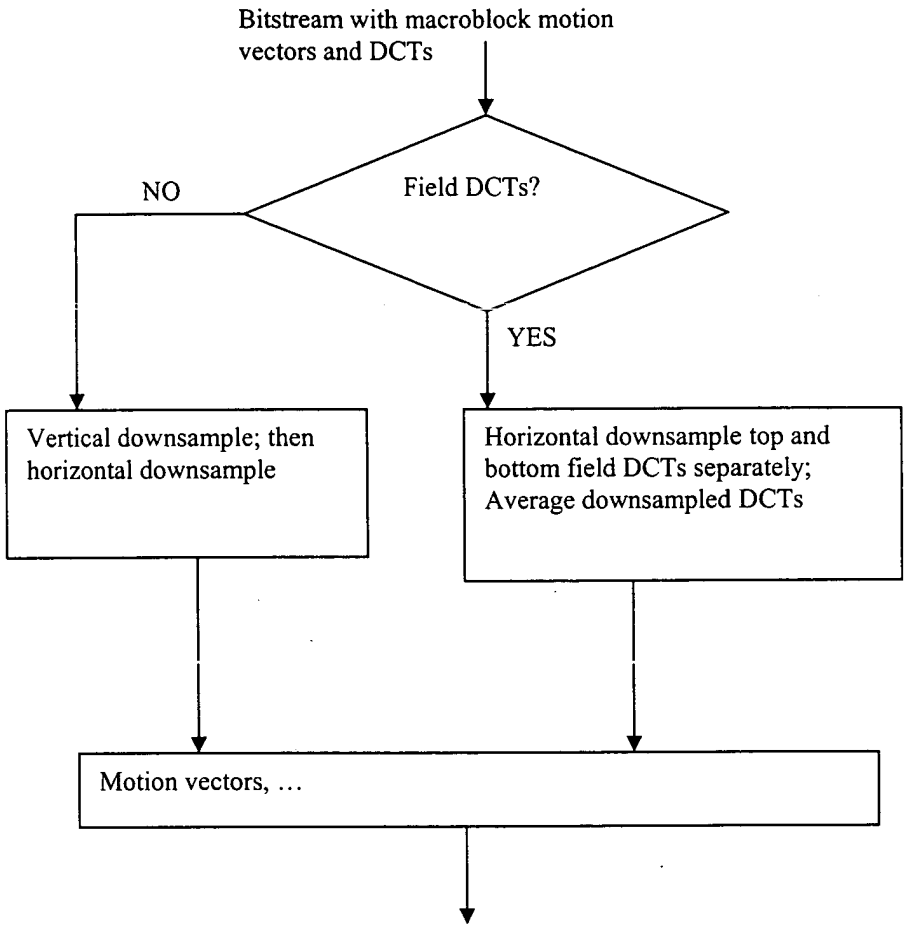

Bitstream with macroblock motion vectors and DCTs
Field DCTs?
NO
YES
Vertical downsample; then horizontal downsample
Horizontal downsample top and bottom field DCTs separately; Average downsampled DCTs
Motion vectors, …

Figure 1c

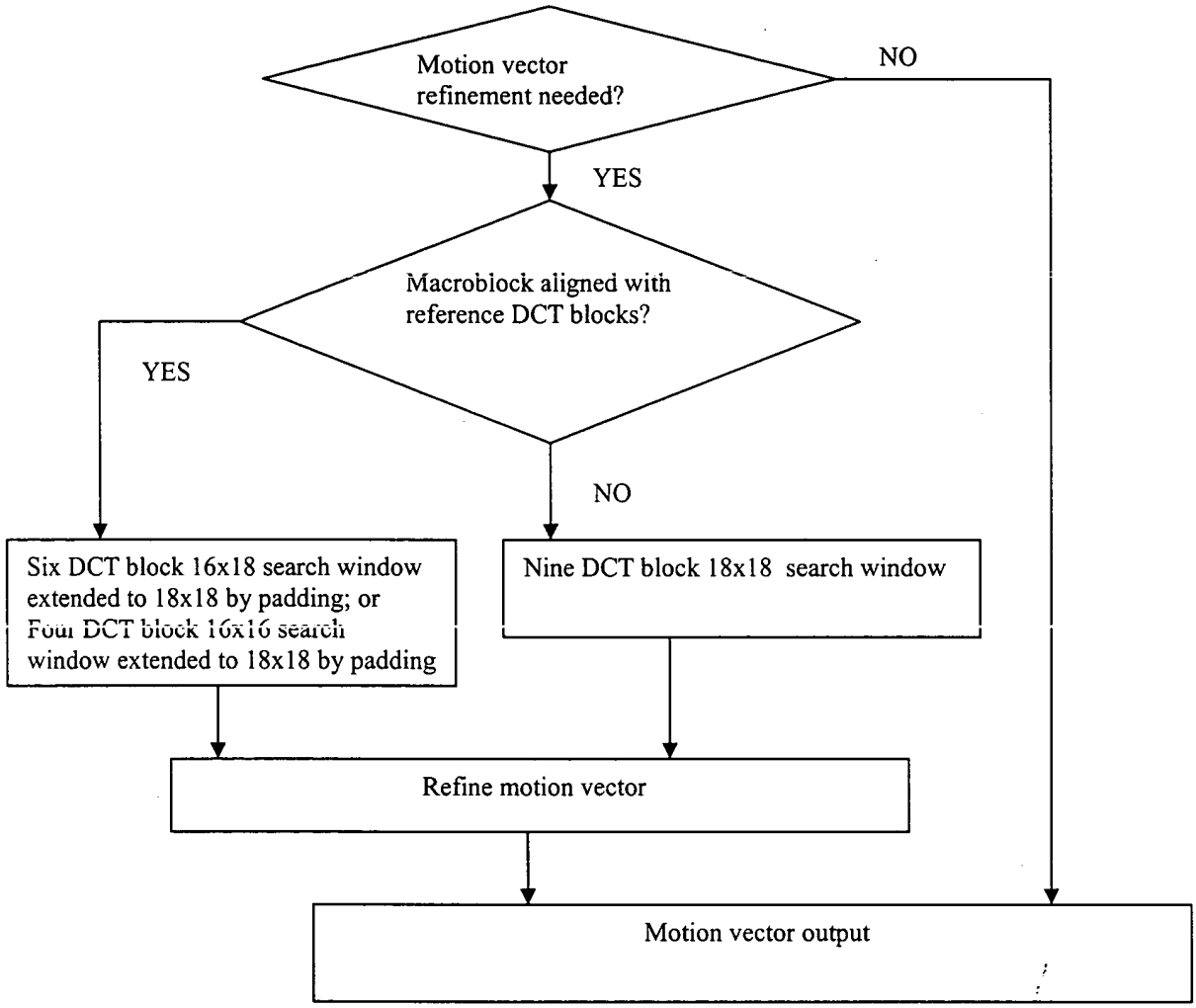

Motion vector refinement needed?
NO
YES
Macroblock aligned with reference DCT blocks?
YES
NO
Six DCT block 16x18 search window extended to 18x18 by padding; or Four DCT block 16x16 search window extended to 18x18 by padding
Nine DCT block 18x18 search window
Refine motion vector
Motion vector output

Figure 1d

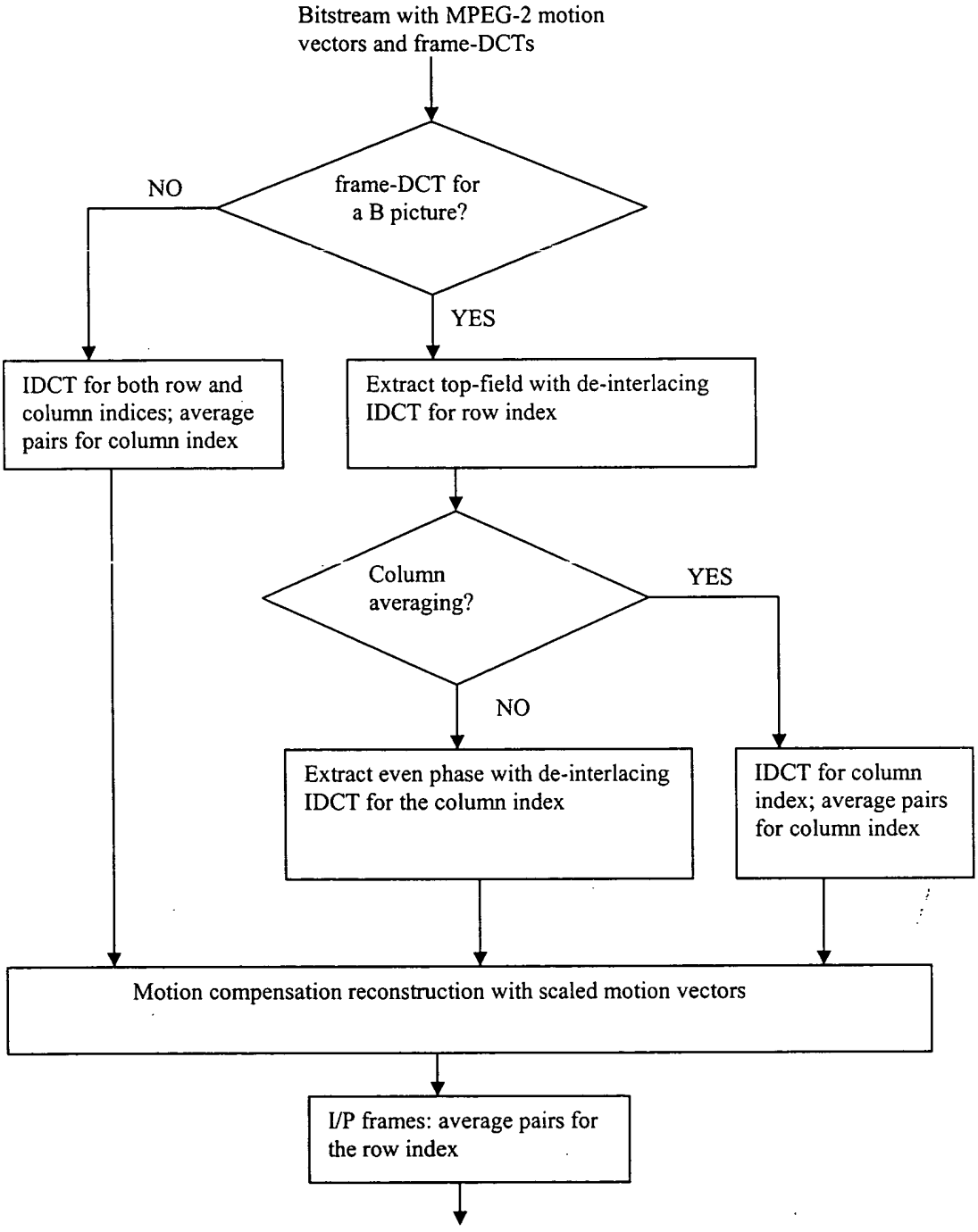
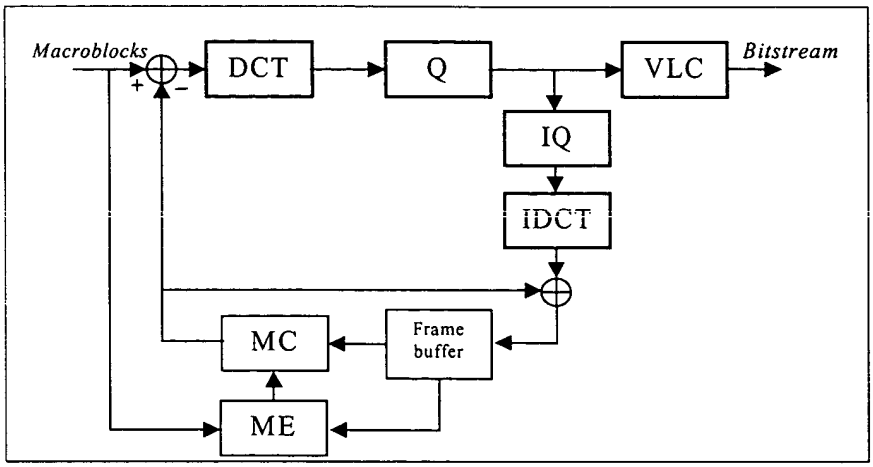

Bitstream with MPEG-2 motion vectors and frame-DCTs
frame-DCT for a B picture?
NO
YES
IDCT for both row and column indices; average pairs for column index
Extract top-field with de-interlacing IDCT for row index
Column averaging?
YES
NO
Extract even phase with de-interlacing IDCT for the column index
IDCT for column index; average pairs for column index
Motion compensation reconstruction with scaled motion vectors
I/P frames: average pairs for the row index

Figure 2a (prior art)



Block diagram of DCT-based video encoding. Q – Quantization, IQ- Inverse Quantization, IDCT- Inverse DCT, ME- Motion Estimation, MC- Motion Compensation, VLC – Variable Length Coding

Figure 2b (prior art)

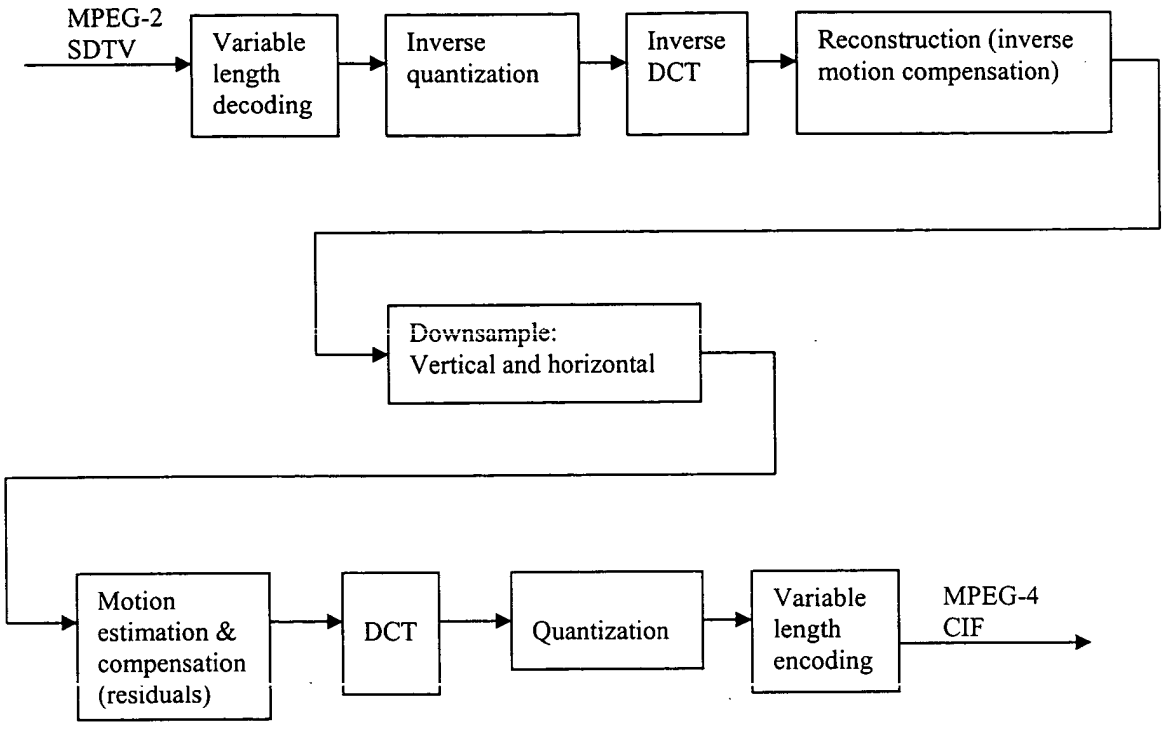


Figure 3a

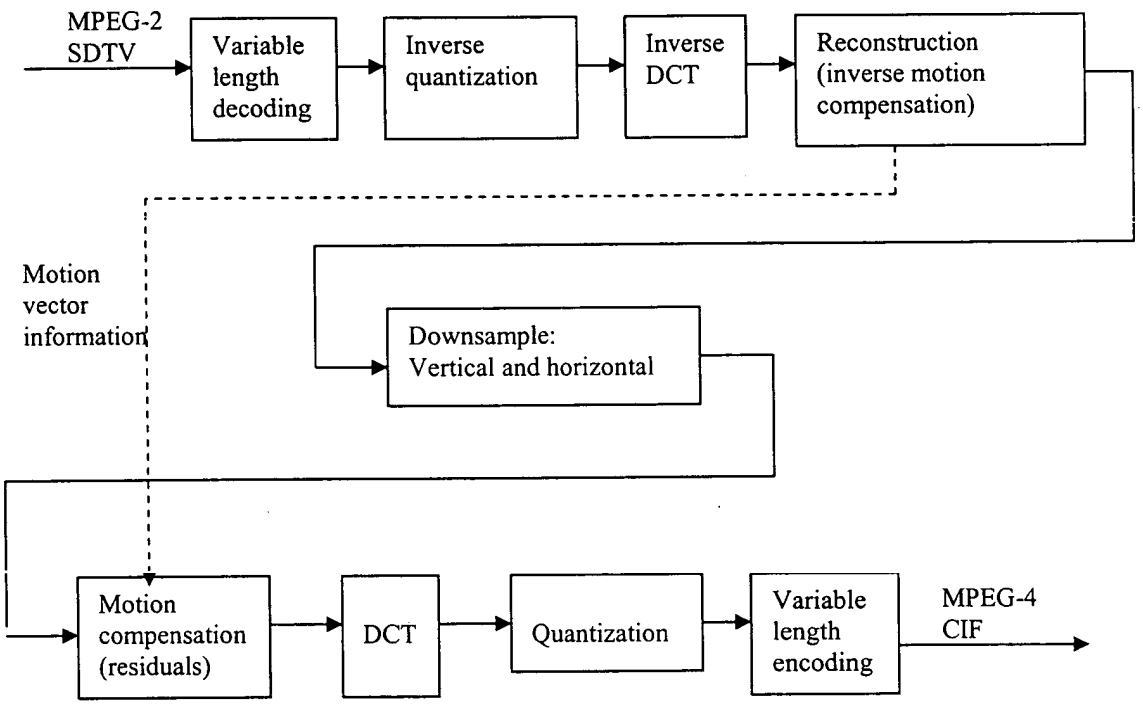

MPEG-2
SDTV
Variable length decoding
Inverse quantization
Inverse DCT
Reconstruction (inverse motion compensation)
Motion vector information
Downsample: Vertical and horizontal
Motion compensation (residuals)
DCT
Quantization
Variable length encoding
MPEG-4
CIF

Figure 3b

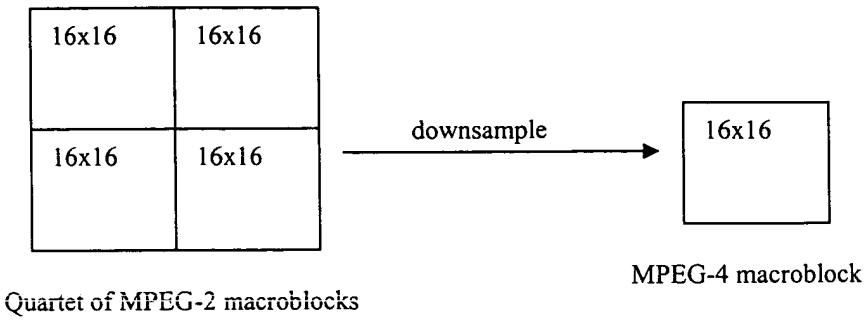


Figure 3c

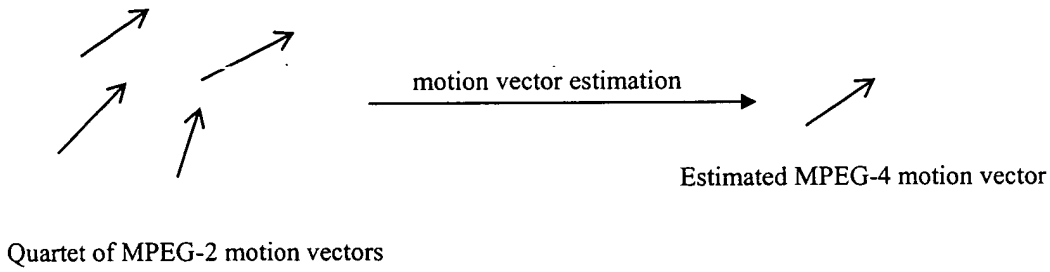


Figure 3d

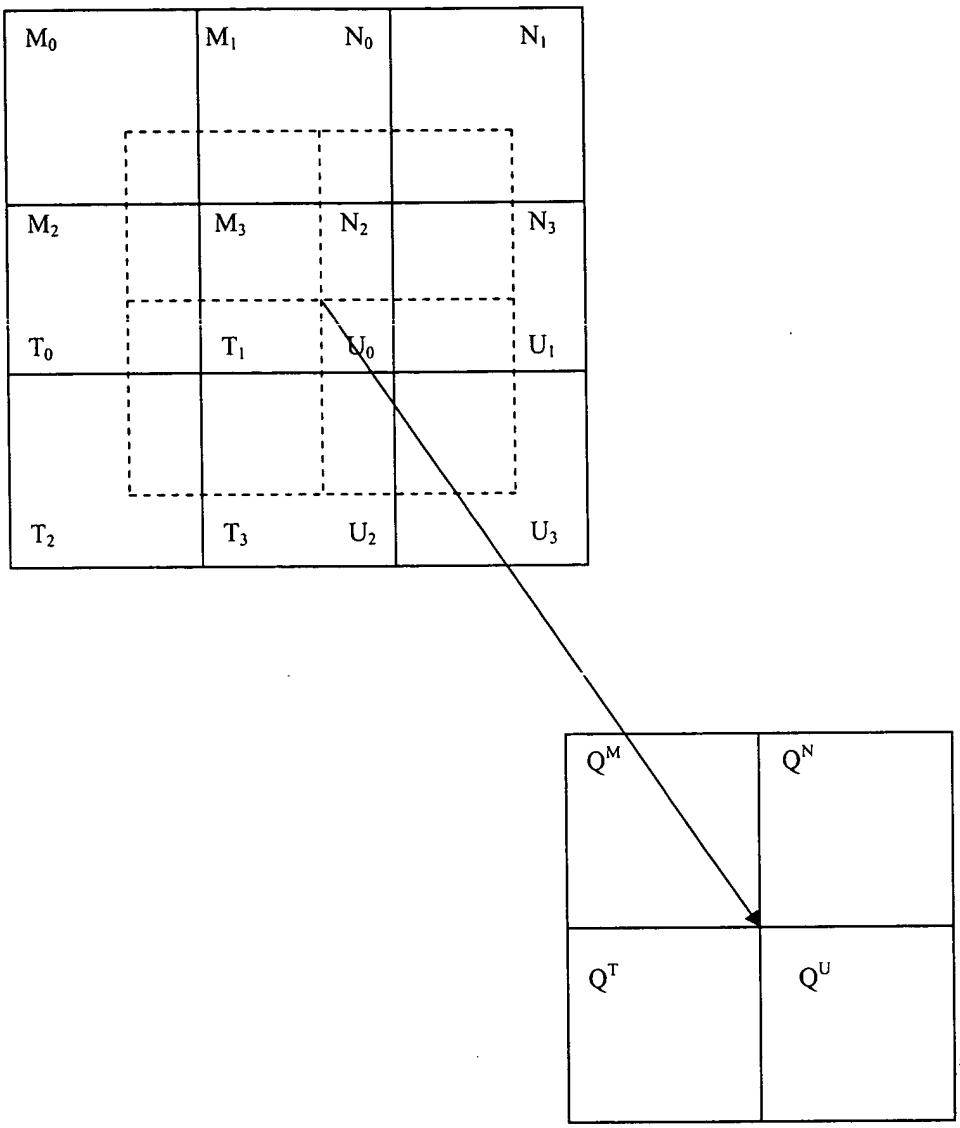


Figure 4a

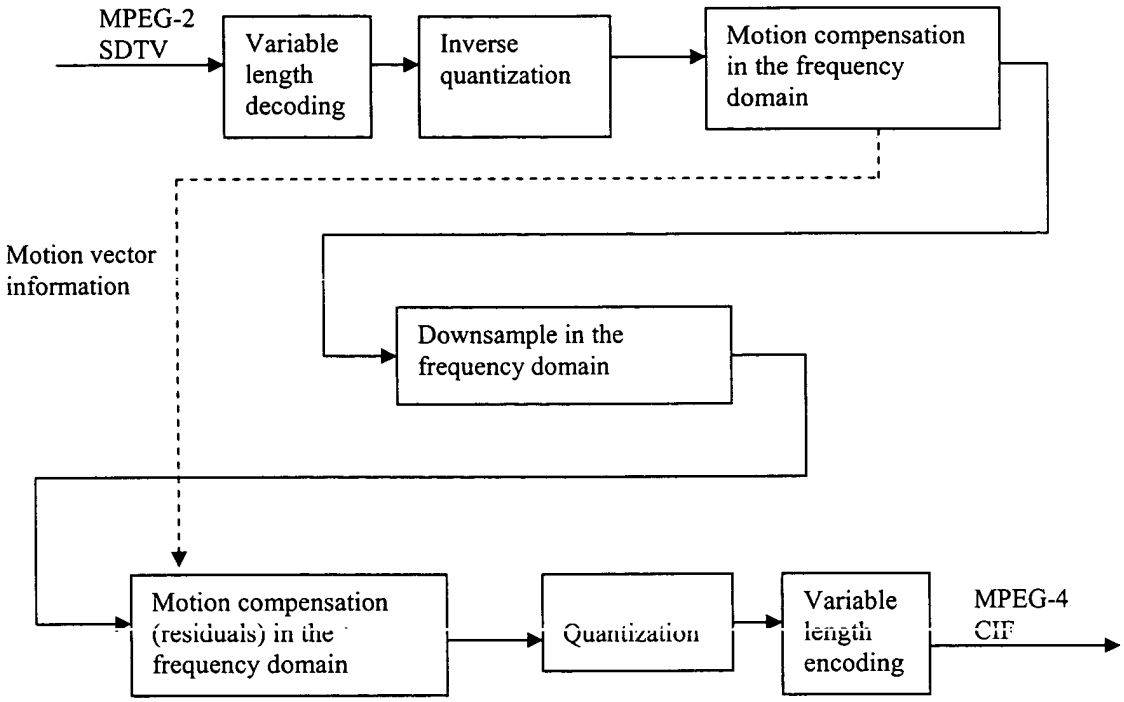
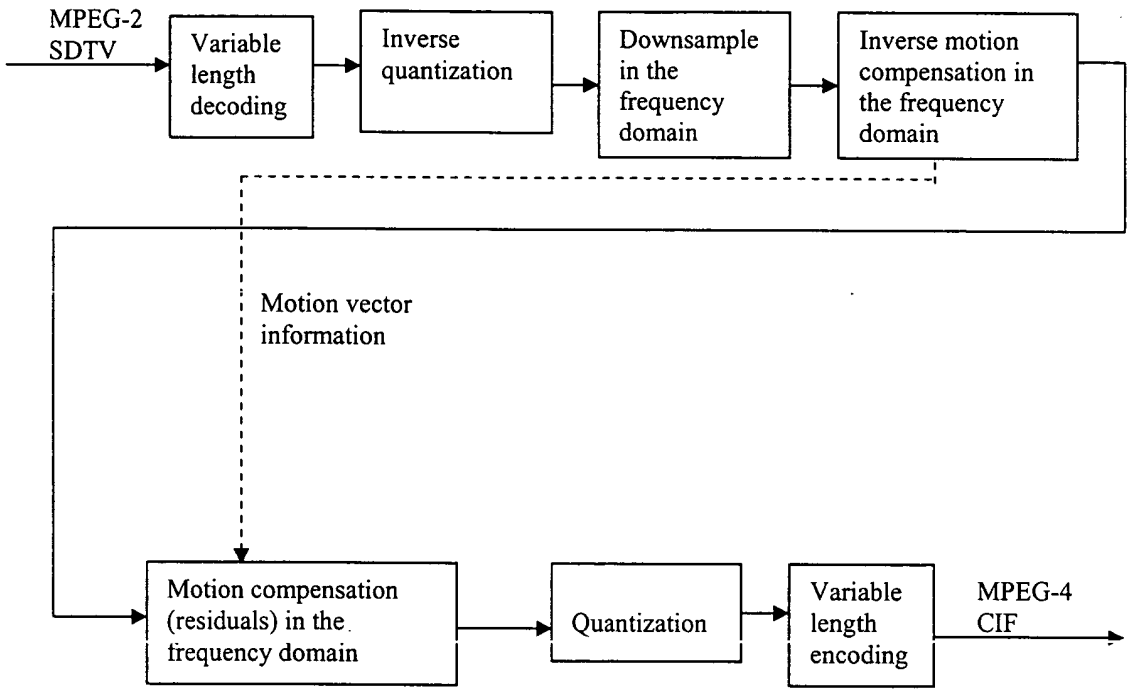

MPEG-2
SDTV
Variable length decoding
Inverse quantization
Motion compensation in the frequency domain
Motion vector information
Downsample in the frequency domain
Motion compensation (residuals) in the frequency domain
Quantization
Variable length encoding
MPEG-4
CIF

Figure 4b


MPEG-2
SDTV
Variable length decoding
Inverse quantization
Downsample in the frequency domain
Inverse motion compensation in the frequency domain
Motion vector information
Motion compensation (residuals) in the frequency domain
Quantization
Variable length encoding
MPEG-4
CIF

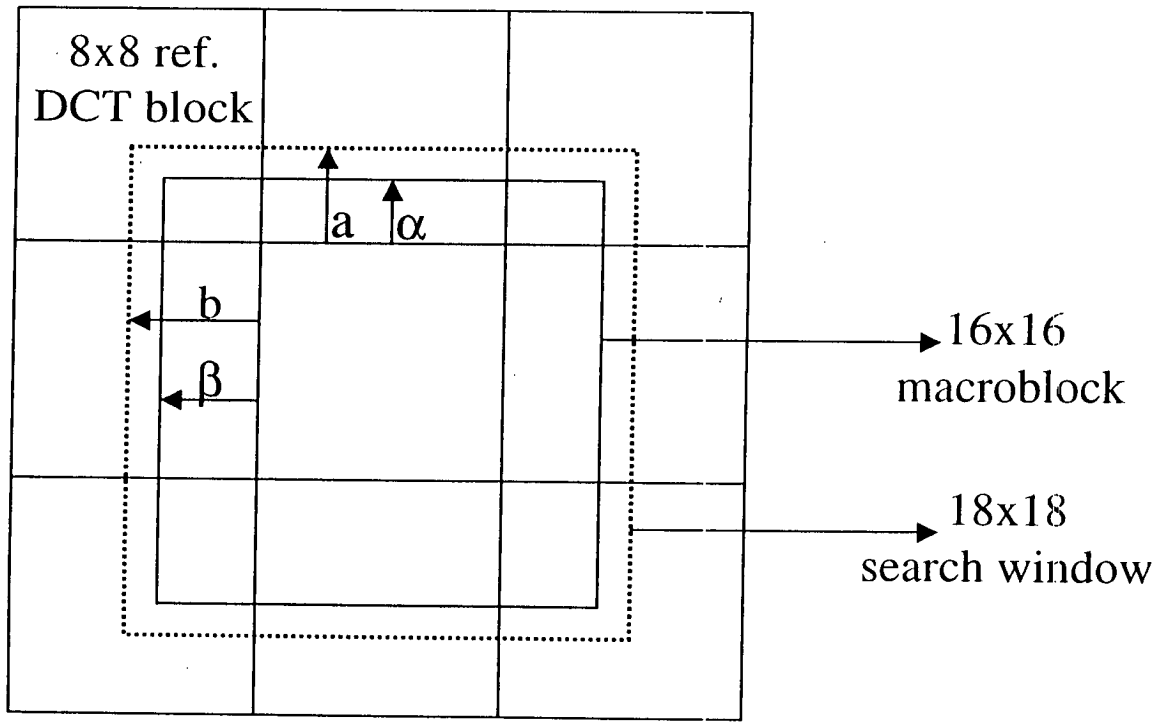


Fig 5a Search window for $\alpha > 0, \beta > 0$

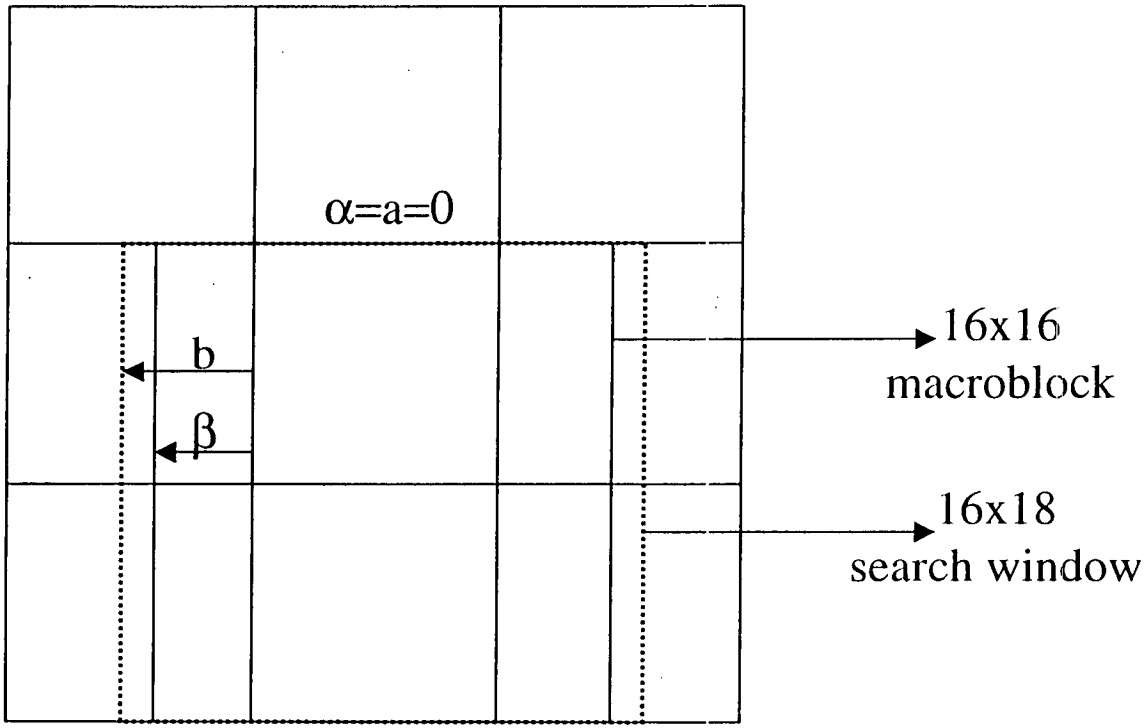


Fig. 5B Search window for $\alpha = 0, \beta > 0$

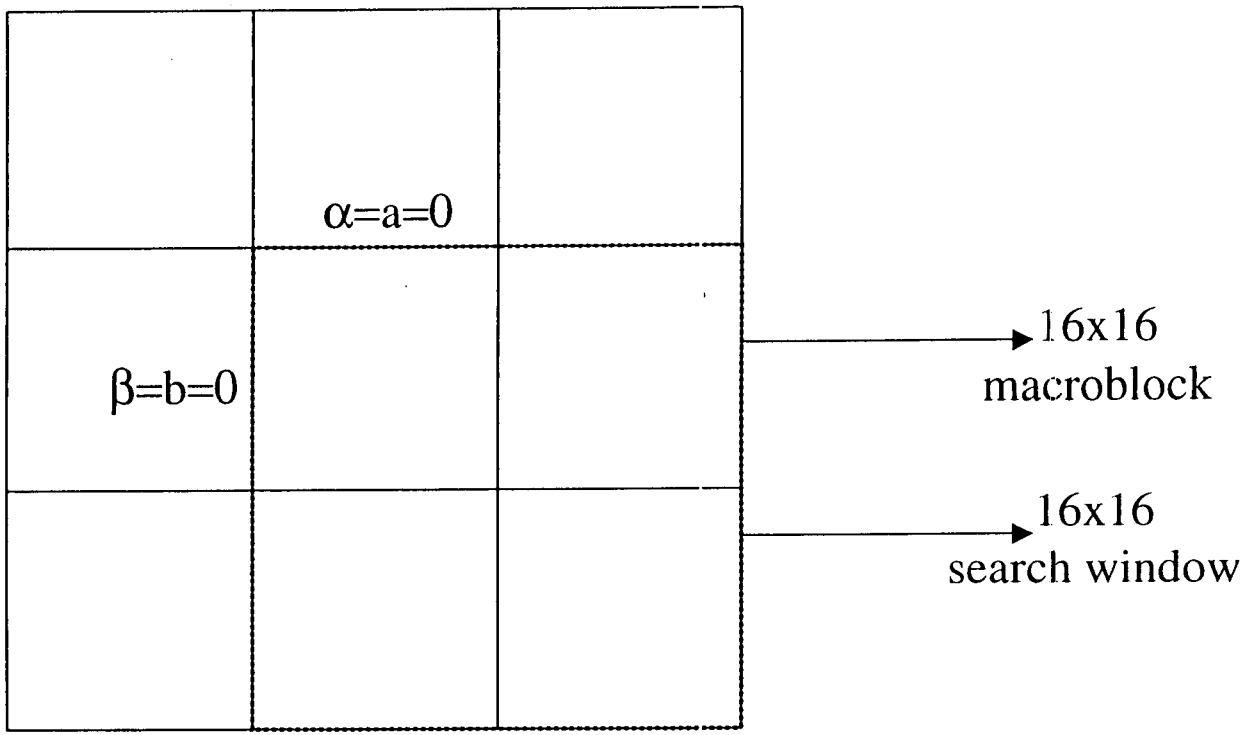
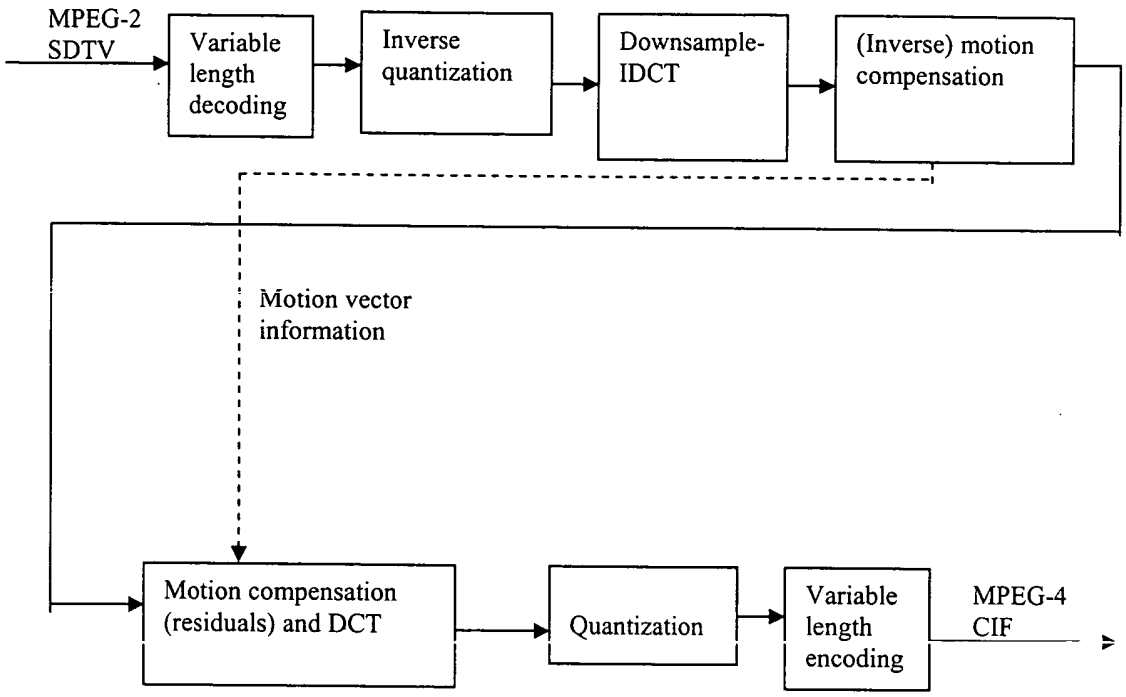


Fig. 5e Search window for $\alpha = \beta = 0$

Figure 6


MPEG-2
SDTV
Variable length decoding
Inverse quantization
Downsample-IDCT
(Inverse) motion compensation
Motion vector information
Motion compensation (residuals) and DCT
Quantization
Variable length encoding
MPEG-4
CIF